SAMPLING PLAN

GOALS AND STANDARDS

Goals

- Collect information generalizable to the general adult population that meets characteristics as defined by each country.
- For household-based surveys, use a multistage sampling plan.

Standards

- Use probability sampling.
- Draw a different sample for each survey cycle.

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Well-trained or experienced staffs are important, as they will be better at persuading respondents to answer the survey. See Section 4 of this guide for more information on staff recruitment and training.

Timing of calls or visits if doing a telephone or a face-to-face survey is very important. Because of the group nature of out-of-home obligations, most households have consistently timed at-home experiences. Try to identify any schedule patterns within different groups or survey units.

The characteristics of the area or structure to be surveyed should give an idea of the efforts needed to make an initial contact. Urban areas with high population density tend to require more calls to make the first contact. Areas with high crime rates require more calls to first contact for face-to-face surveys. Large multiunit structures also require more effort to contact. Physical impediments to access (security doors, locked entrances, etc) tend to slow down contact.

Working with a statistical consultant

It is difficult and often impossible to fix problems after the fact. A statistician should be involved at the outset of your surveillance effort. The statistician should be familiar with the surveillance goals and objectives.

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Nonresponse error can create biased estimates. Because nonresponse is inversely related to response rate, surveys with higher response rates will generally have lower nonresponse bias. Nonresponse can occur both at the household and person level.

There are different types of nonresponse in household surveys:

- No one was contacted
- The person contacted refused to answer the question
- The person contacted was unable to respond (language problem, mental/physical health problem,etc.)

Nonresponse error is the extent to which respondents differ from nonrespondents on characteristics of importance in the survey. Therefore, nonresponse errors may introduce a bias in the survey results. Reducing nonresponse error consists of obtaining the best response rate possible.

The survey method should be determined by which would be the most appropriate for the types of questions and the population surveyed. Studies have shown that some specific populations are more or less likely to respond to various survey methods. For example, less educated people are more likely to respond to a telephone survey than a mail survey, which requires reading and writing skills.

When doing nonresponse followup, switching to another survey method can be effective. For example, if the initial method of collection was through a mail survey, switch to a telephone survey or face-to-face interview for the followup effort.

Incentives can be offered to increase participation. These can include money, free health or lifestyle assessment, gifts, a lottery, and others that would be appropriate to a country or region.

Make sure the respondents know that the information they provide will be confidential. Sending an advance letter to respondents can be effective if it is official and personalized. Increase the buy-in of the survey by explaining to the respondents how important it is that they respond to the questionnaire for the good of their community.

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Certain subgroups may need to be oversampled to ensure adequate response rates of subgroups.

Creating sample stratification

Stratification of the sample can be used to reduce sampling error. In a stratified sample, the sampling error depends on the population variance existing within rather than between the strata. Another reason for stratification is that where marked differences exist between subgroups of the population (e.g., urban, rural), stratification allows flexible selection of sample allocation and design separately for each subgroup.

Stratification is used only at the first stage of sampling. There is no benefit to stratifying at the dwelling or household selection stage.

Decreasing sources of error

Sources of error include noncoverage error, nonresponse error, unit nonresponse, and item nonresponse.

Noncoverage error occurs because not all members of the general population are included in the sample. Population groups typically excluded from most general population surveys include persons living in nonresidential settings, such as hospitals, nursing homes, prisons, military bases, homeless shelters, and college dormitories. Compared with the size of the population of a country or region as a whole, the number of persons in these groups is generally small.

Nonresponse error is the inability to obtain data for all persons in the sample population. This is a common problem in surveillance work. Information is presented below on reducing this type of error.

Unit nonresponse occurs when an eligible sampling unit (a household, a person) does not respond or a respondent refuses to participate in the survey. **Item nonresponse** occurs when useful data are not obtained for a particular questionnaire item.

Reducing nonresponse error

With continuous surveillance, it becomes easier to deal with the problem of nonresponse. It is possible to do some analysis on the nonrespondents because we know what characteristics they have. The next step would be to identify what nonresponse comes from error, and what comes from bias.

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attempts to compensate for such features of the same design, statisticians apply devices that tend to reduce variances, principally stratification and sophisticated weighting methods. However, the features that tend to increase variances usually dominate.[4]

The design effect is a measure of the extent to which the interactions of all such features affect the sampling variance. It is defined as the factor by which the variance of an estimate is changed through departure from simple random sampling. A design effect value of 1 indicates that the sample design is as efficient as a simple random sample. A value greater than 1 indicates a tendency for greater sampling error since a more complex and less statistically efficient design was used. Once the sampling plan has been determined, the design effect may be estimated using a statistical package, such as SAS. However, for new surveys, the design effect is usually not known. An estimate probably can be made using data from other surveys in similar areas.

For a well-designed survey, the design effect usually ranges from 1 to 3. But it is not uncommon for the design effect to be much larger, up to 7 or 8, or even to 30.[5]

Rules need to be established for sample replacement. It is important to have as high a level of participation among those selected in the original sample as possible.

Sampling subgroups

Information on subpopulations, such as racial or ethnic minority groups, must be considered when determining sample size to ensure an adequate number of respondents within these subpopulations to produce estimates with an accepted level of precision. Population subgroups may also be referred to as survey domains.

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[4] Assessment of major federal data sets for analyses of Hispanic and Asian or Pacific Islander subgroups and Native Americans: Extending the utility of federal data bases. Section 2. Methodological and Statistical Issues Affecting a Survey's Ability to Produce Adequate Precision. Department of Health and Human Services/Assistant Secretary for Planning and Evaluation, May 2000. Available online: http://aspe.hhs.gov/hsp/minority-db00/task3/section2.htm>

[5] Shackman G. Sample size and design effect. Presented at Albany Chapter of American Statistical Association, March 24, 2001.

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If simple random sampling is **not** used, some adjustment is needed for the estimated sample design effect. For example, if cluster sampling is used, the precision of estimates would be lower than would be obtained through simple random sampling. This means that a larger sample size must be obtained than would be required with simple random sampling. The design effect cannot be determined until after the data are collected, but it must be estimated in advance to determine sample size.

It is important to understand the role of design effect in determining the precision of a survey estimate. Design effect is a factor that reflects the effect on the precision of a survey estimate due to the difference between the sample design actually used to collect the data and a simple random sample of respondents. Design effect can only vary not from survey to survey but also from question to question.

When the sampling unit is households, design effect is higher for characteristics that are the same for all members of the household, such as ethnicity, and lower for characteristics such as age and education.[3]

The clustering frequently results from several stages of sample selection, e.g., countries, provinces, municipalities, groups of neighboring households, and members of sample households. The extent to which the characteristics of persons within these levels of clustering tend to be correlated influences the size of the sampling variances. In most cases, clustering increases the sampling variances above what would result from a simple random sampling with the same sample size. Variances will also be increased if the sampling rates vary among members of the population. This can come about if some groups are oversampled or undersampled. It can also result from a fairly common practice of selecting a household sample, then choosing one member at random for a more detailed interview. Persons in large households then have smaller probabilities of selection than persons in small households. In

[3] U.S. Census Bureau. Technical paper 63: Current Population Survey design and methodology. Available online: http://www.bls.census.gov/cps/tp/tp63.htm

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of estimates. This is called design effect. If clusters of households are used to lower survey costs and reduce survey burden, the design effect will likely be greater than one. To compensate for this, a larger sample is necessary to achieve the same degree of statistical power.

Identifying sampling requirements

Sample size must be adequate to provide reasonable estimates of the prevalence of risk behaviours and preventive health practices among residents. Sample size can vary depending on data needs and availability of funds.

The objectives of the surveillance system — that is, the subject areas for which data are desired — must be carefully evaluated. If the behaviour of interest is uncommon in the general population (e.g., less than 10%), the overall sample size will have to be large enough to include a sufficient number of respondents engaging in the uncommon behaviour.

Information on subpopulations, such as racial or ethnic minority groups, must be considered when determining sample size to ensure an adequate number of respondents within these subpopulations to produce estimates with an accepted level of precision.

Multistage cluster sampling is typically used in surveillance. Clustering sampled households in a limited number of geographic areas will help reduce the cost of data collection[2] by helping to keep staff and travel costs down.

The tolerable range of error must be identified. For example, estimates with a range of error of $\pm 3\%$ will require a much larger sample size than estimates with a range of error of $\pm 10\%$. In addition, the desired level of confidence, indicating that the true value is within the tolerable range of error, has to be established. Typically, the 95% confidence level is used (although other levels can be selected). The smaller the required confidence interval, the greater the sample size requirement.

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[2] L. Alecxih, J. Corea and D. Marker. Deriving state-level estimates from three national surveys: A statistical assessment and state tabulations. Department of Health and Human Services/Assistant Secretary for Planning and Evaluation, May 4, 1998. Available online: http://aspe.hhs.gov/health/reports/st_est/

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Source: https://www.industrydocuments.ucsf.edu/docs/nrnj0001

Ensuring a scientific approach

Because interviewing every person is not economically feasible, the surveillance system should use a scientifically selected sample. The sample must be representative of the whole population. This will ensure that the data are credible and the evidence base for health risk is strengthened. Information obtained from a scientifically selected sample can be used to generalize results to the total population. You will need a valid technique for drawing the sample.

Using probability sampling

Probability sampling is a method of random sampling in which each member of the population has a known, nonzero probability of being selected.

Several types of sampling designs will yield a probability sample. These sampling designs are described under "Determine sample methodology" in the Action Steps of this chapter.

Assuring sampling efficiency

A good sample design is efficient. An efficient sample produces results that are more precise than those from other samples of the same cost. The more precise your results, the more confidence you can have in them. An efficient sample design is dependent on both sample size and the selection procedures. For a given sample size, more precise results can be obtained by conducting the survey in a larger number of neighborhoods or towns. This is particularly true when residents in the same town tend to be more similar than residents in other towns.

Samples obtained using large numbers of residents in only a few neighborhoods will tend to reflect the characteristics of the particular neighborhoods that are selected. Estimates from such samples will result in relatively high variability of the estimates and less precision. In contrast, samples that are obtained using small numbers of residents in many neighborhoods will more accurately reflect the population. In general, estimates from these samples will be close to the values for the entire population, that is, they will have better precision. Very large samples are usually not necessary because they require more documentation and more followup for only a slight increase in precision.

Both cluster sampling and disproportionate stratified random sampling make sampling easier, but at a cost of decreased precision

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SAMPLING PLAN

Calculate the sample size

The required sample size can vary depending on data needs and availability of funds. Sample size must be adequate to provide reasonable estimates of the prevalence of risk behaviours and preventive health practices among the various subgroups on which you want to collect data. The more subgroups for which you want to collect information, the larger your sample size will need to be. In addition, if a behaviour of interest is uncommon in the general population, the overall sample size will have to be large enough to include a sufficient number of respondents who engage in the behaviour.

Be sure to seek input and guidance from a statistical consultant.

Determine sample methodology

Probability sampling is a method of random sampling in which each member of the population has a known, nonzero probability of being selected. Several types of sampling designs will yield a probability sample. These are:

- **Simple random sample** — Each "unit" in the surveillance population has an equal probability of being surveyed.

- **Stratified random sample** — The population is divided into a specified number of subpopulations, or strata (e.g., north/south, urban/rural), and a sample is drawn independently from each stratum. Stratified random sampling is comparable to conducting a number of independent surveys of subpopulations, then combining data from these separate surveys (strata) to produce an overall estimate.

- **Cluster sample** — The sampling unit is a group, or cluster, rather than an individual. The clusters are usually of equal size. Cluster sampling of households reduces the number of individuals to be selected in order to complete a sample. Cluster sampling is easier and less expensive but often results in increased variance for measurements

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- **Disproportional stratified random sample** — This is a variation of cluster sampling. Information from previous surveys is used to classify units into strata that are either likely or unlikely to be selected. Units in the likely stratum are sampled at a higher rate than those in the unlikely stratum.

Nonprobability sampling methods may produce reasonable estimates, but if there are unexpected findings or results, it may not be possible to determine if they are the result of the sampling plan or attributable to other variables.

Take sources of sampling error into account. These include noncoverage error, nonresponse error, unit nonresponse, and item nonresponse. All steps should be taken to reduce nonresponse.

Obtain a sampling frame

Geographic coverage should ultimately include your entire country unless there are specific reasons for excluding certain areas. You may want to survey only selected areas or regions at first as you build capacity toward an expanded surveillance system for your entire country.

If an adequate sampling frame exists from another ongoing national survey, such as census data collection, it could be used. The frame should include all of the population in the area under consideration, with the possible exception of geographic areas that are inaccessible or have widely dispersed populations.

An existing sampling frame can be utilized only if sufficient information is available to demonstrate that its parameters are acceptable and that it is up to date. If an existing sampling frame is not current, it will need to be updated.

The advantages of using an existing sample are:

- Cost-effectiveness
- Increased analytic power

The disadvantages include:

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SAMPLING PLAN

The quality and usefulness of results from your surveillance system depend largely on the procedures used to select the participants. Because interviewing every person is not economically feasible, the surveillance system should use a scientifically selected representative sample.

Action Steps to be taken for formulating a sampling plan include:

1. Calculate the sample size
2. Determine sample methodology
3. Obtain a sampling frame
4. Create a list of dwellings or households
5. Select the sample

Important Considerations to take into account when developing a sampling plan include:

1. Ensuring a scientific approach
2. Using probability sampling
3. Assuring sampling efficiency
4. Identifying sampling requirements
5. Sampling subgroups
6. Creating sample stratification
7. Decreasing sources of error
8. Reducing nonresponse error
9. Working with a statistical consultant

Goals and Standards for a good sampling plan include:

Goals:

1. Collect information generalizable to the general adult population that meets characteristics as defined by each country.
2. For household-based surveys, use a multistage sampling plan.

Standards:

1. Use a probability sample.
2. Draw a different sample for each survey cycle.

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